

**MAYACNEPHIA SALASI (DIPTERA: SIMULIIDAE), A NEW  
BLACK FLY SPECIES FROM COSTA RICA**

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*Abstract.*—The female, male, pupa and larva of *Mayacnephia salasi*, new species, are described and illustrated. This genus is recorded from Costa Rica for the first time, and is now known from western North America, Mexico, Guatemala, Costa Rica and Panama. A key to the species of *Mayacnephia* known in the pupal stage is provided.

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The genus *Mayacnephia* Wygodzinsky and Coscarón (1973) was established to include six Mesoamerican species that had been placed previously in the genus *Cnephia* Enderlein. Díaz Nájera (1971) described another new species in the genus *Cnephia* that belongs in *Mayacnephia*, and J. L. Petersen (1985) described a new species from Panama. B. V. Peterson (1981), using an expanded concept of the genus, assigned two species to it from western United States and an undescribed species from Canada. The species described below is the eleventh described species now assigned to the genus and the first to be reported from Costa Rica. We describe this new species to make its name available for biological studies currently being conducted on black flies in Costa Rica. We also provide a key to the known pupae of *Mayacnephia*, including the undescribed species from Canada, and include distributions and references to published figures of these species.

***Mayacnephia salasi* Ramirez-Pérez,  
Peterson, and Vargas,  
NEW SPECIES  
Figs. 1-18**

Female (preserved in alcohol).—General body color dark brown. Length: body, 2.88 mm; wing, 3.48 mm.

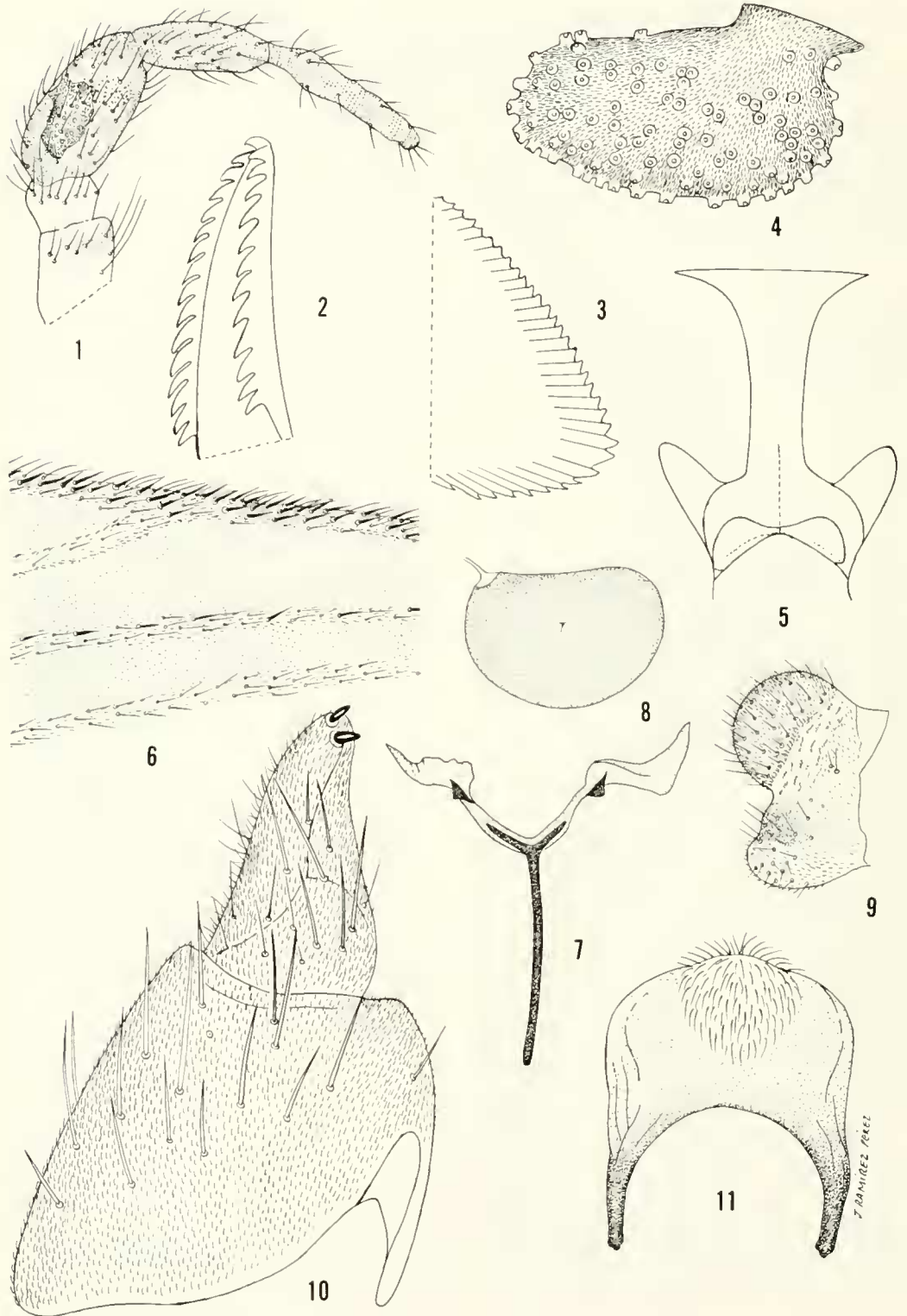
*Head:* Lightly grayish pollinose. Frons (Fig. 5) narrow, nearly parallel sided, only slightly widening dorsally, about five times as long as width at narrowest point, about  $\frac{1}{2}$  width of head; slightly paler than occiput, densely covered with long, decumbent, pale yellow pile, and with a few black setae laterally. Clypeus concolorous or slightly lighter than frons; slightly longer than wide; densely covered with long, ventromedially directed, pale yellow pile interspersed with some dark setae laterally and ventrally. Occiput densely covered with long, pale yellow pile and with a few dark setae mid-dorsally; postocular setae black, closely bending over eye margin. Antenna with nine flagellomeres; scape and pedicel pale yellowish, contrasting with rest of flagellum which is dark brown; pedicel and first flagellomere larger than other antennomeres and subequal in length and width; remaining flagellomeres subequal in length to each other but tapering in width distally; fine pubescence and longer setae dark. Mandible (Fig. 3) with 33-40 serrations. Blade of maxilla (Fig. 2) with 21-25 retrorse teeth. Palpus (Fig. 1) dark brown to black, proximal two palpomeres pale brownish, distal two palpomeres slightly lighter brownish than palpomere three, all with black setae; palpomere five about  $\frac{1}{3}$  longer than palpomere three. Sen-

sory vesicle as in Fig. 4, about  $\frac{1}{2}$  as long as its segment, proximally situated, its neck short, arising anterodorsally and extending vertically, with an enlarged ovoid mouth. Median proximal space of cibarium shallow, broadly U-shaped, and without denticles; dorsolateral arms short, rather broad, sclerotized, inner surface of each arm with a rather extensive patch of minute setulae arising from dark granular bases.

*Thorax:* Anteprenotal lobe concolorous with scutum, with dense, long, pale yellow pile interspersed with a few dark setae. Postpronotum yellowish brown, distinctly paler than scutum, covered with long, semi-erect pale yellow pile. Scutum dark brown to blackish brown except lateral margins which are narrowly paler, and with a grayish pollinose border extending around lateral and hind margins, posterior declivity broadly grayish pollinose; each anterolateral corner of scutum, adjacent to postpronotal lobes, a paler yellowish brown color which, in posterior view, extends posteriorly as a faint, narrow, submedian line, and with a similar faint, slender, median line or vitta that extends to posterior declivity, these lines not visible in anterior view; scutum densely covered with short, recumbent, pale yellow pile that is longer along anterior and lateral margins and still longer posteromedially, also a few scattered dark setae present. Scutellum paler brownish than scutum, lightly grayish pollinose, densely covered with long, pale yellow and dark setae. Postnotum only faintly darker than scutellum, with a faint pollinosity. Anterior half of pleuron dark brown mottled with some paler areas, and distinctly paler brown on posterior half that is mottled with some darker areas; presteranal lobe with moderately long pale yellow pile; anepisternal membrane distinctly paler than rest of pleuron; mesepimeral tuft dark. Wing (Fig. 6) membrane hyaline but with a light brownish tinge; veins yellowish brown. Base of C, stem vein, and other veins with dark pile; Sc setose ventrally;  $R_1$  setose dorsally;  $R_{4+5}$  setose ventrally; cell bm present;

C with spiniform setae as long as regular setae, apical half of  $R_1$  with a few similar spiniform setae; fringe of anal lobe and calypter pale yellow. Stem of halter and base of knob brownish yellow, rest of knob yellow; stem with pale yellow pile. Legs rather uniformly dark brown; all coxae with both pale and dark setae but pale setae more numerous on fore and midcoxae, rest of setae on legs dark; hind basitarsus about seven times as long as broad. Calcipala short but distinct, broadly rounded; pedisulcus absent. Claw only slightly curving from base, with a prominent, bluntly pointed, basal tooth that is wider than claw and over  $\frac{1}{2}$  as long.

*Abdomen:* Yellowish brown, basal scale (tergite one) dark brown, with a fringe of long, pale yellow pile; tergites broad, tergite two widest, others decreasing in width posteriorly; tergites yellowish centrally with darker brown margins, sparsely covered with short, pale yellow setae; pleural membrane paler and more yellowish brown, with both pale yellow and dark setae; sternites scarcely distinguishable; venter of abdomen pale brownish yellow, with mostly short, dark setae but with some scattered pale yellow setae. Terminalia as in Figs. 7–9. Anal lobe (Fig. 9) narrow dorsally, broadening ventrally, widest at about midheight, broadly rounded ventrally, with a slight but distinct notch posteroventrally, not produced beneath cercus, moderately setose. Cercus subrectangular, hind margin varying from strongly rounded to nearly straight. Hypogynial valves short, barely reaching to bases of cerci; valves subtruncate posteriorly, their medial margins lightly sclerotized; lightly setose. Stem of genital fork (sternite nine) (Fig. 7) long, heavily sclerotized, slightly more than  $\frac{1}{3}$  longer than arms; arms short, rather weakly sclerotized except for a short, heavily sclerotized rodlike extension on each side emanating from stem of genital fork; arm with a sclerotized subtriangular toothlike process on anterior margin; arms rather broadly attached to tergite nine. Spermathe-



ca (Fig. 8) kidney-shaped, moderately sclerotized, with a faint, loose reticulate pattern but without internal spicules; with only a small clear area at junction with spermathecal duct.

Male (preserved in alcohol).—General body color velvety dark brown to black. Length: body, 3.12 mm; wing, 3.18–3.45 mm.

*Head:* Frons and clypeus lightly grayish pollinose, with erect, black pile. Occiput with long, dark brown to black setae. Antenna entirely dark brown; first flagellomere angularly broadened distally, slightly longer than pedicel; fine pubescence pale yellow, longer setae black. Palpomere three darker than other palpomeres, all with black pile interspersed with a few more yellowish setae; palpomere five about  $\frac{1}{3}$  longer than palpomere three and about  $\frac{1}{2}$  longer than palpomere four. Sensory vesicle about  $\frac{1}{3}$  as long as its segment; neck short, enlarging to form a round mouth.

*Thorax:* Antepnotum and postpronotum concolorous, slightly paler brown than scutum; with some dark setae and some pale yellow pile having dark bases. Scutum with a light grayish pollinosity; densely covered with short, recumbent, pale yellow pile that is longer anteriorly, laterally and postero-medially. Scutellum brown, paler than scutum; densely covered with long, erect, dark setae and some decumbent, pale yellow setae. Postnotum concolorous with scutellum, lightly grayish pollinose. Pleuron brown anteriorly, grayish pollinose, becoming paler brown medially and posteriorly; anepisternal membrane brownish yellow; mesepimeral tuft dark. Wing membrane hyaline but with a distinct brownish tinge, veins yellowish brown. Base of C, stem vein, and other veins with dark pile; Sc lightly setose

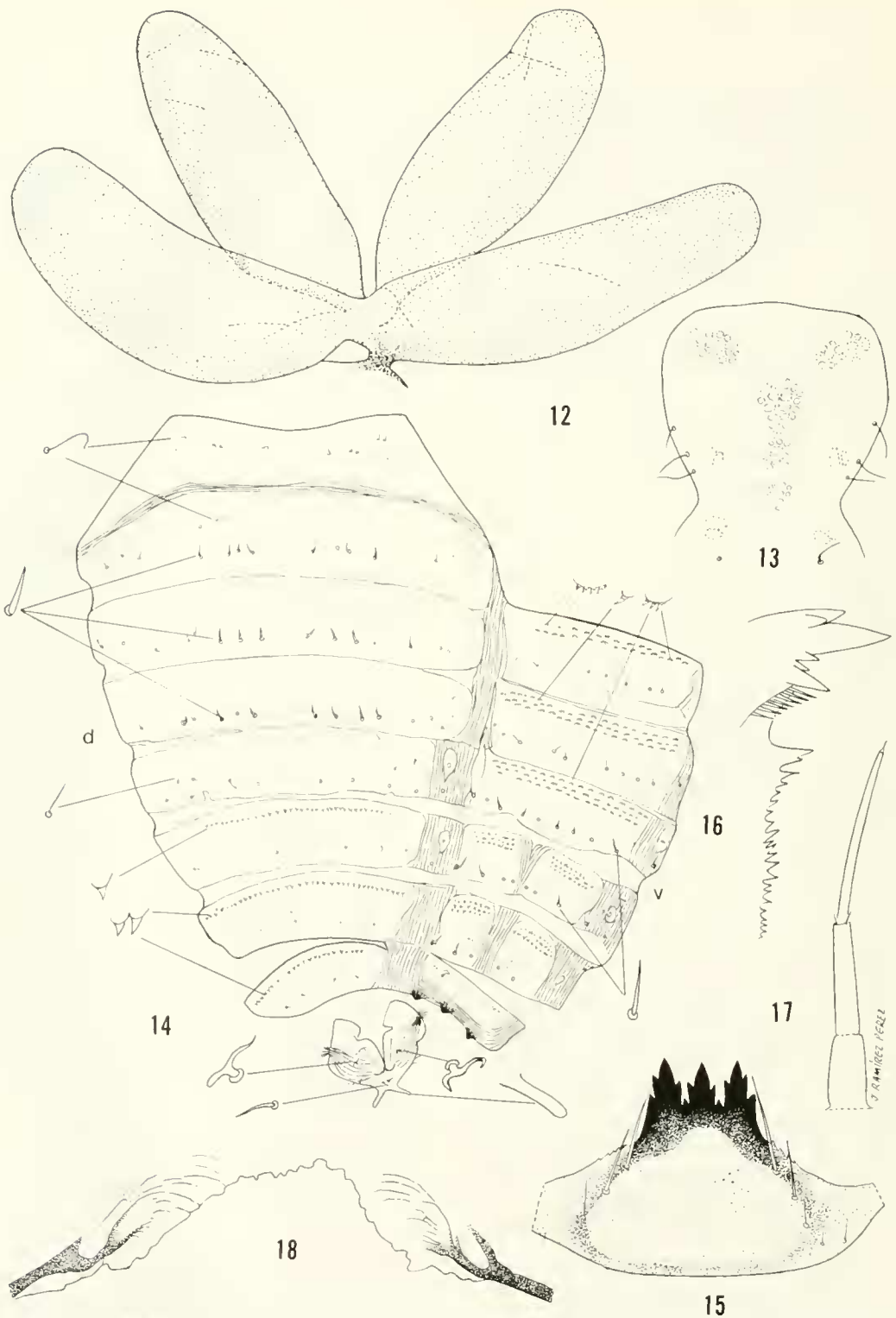
ventrally;  $R_1$  setose dorsally;  $R_{4+5}$  setose ventrally; C and about distal  $\frac{2}{3}$  of  $R_1$  with spiniform setae that are about as long as regular setae; cell bm present; fringe of anal lobe brownish yellow; fringe of calypter pale yellow. Knob of halter brown, stem yellow with pale yellow pile. Legs rather uniformly dark brown, with dark pile; hind basitarsus swollen, about 3.5 times as long as broad; calcipala short but distinct, rounded apically; pedisuleus absent.

*Abdomen:* Basal scale dark brown, with a fringe of long dark pile; tergites with darkened margins, paler medially, covered with short, brown pile; sternites concolorous with tergites, with long, dark setae. Terminalia as in Figs. 10 and 11. Gonocoxite (Fig. 10) subtriangular to conical, greatest length and width nearly equal, covered with pile on all but basal  $\frac{1}{4}$  to  $\frac{1}{3}$ . Gonostylus short, about  $\frac{1}{2}$  longer than greatest width at base; tapering to a bluntly pointed, apical margin bearing two tiny terminal spines. Body of ventral plate of aedeagus (Fig. 11) subrectangular, broader than long, with a short, ventrally directed hirsute lip; in ventral view, apical margin slightly convex and shortly produced nipplelike medially, lateral margins slightly concave just distal to junction with basal arms; basal arms bowed, nearly equal in length to body of ventral plate; median sclerite of aedeagus short, Y-shaped, stem variably longer than arms; aedeagal membrane rather densely covered with numerous groups of 8–10 minute setulae arranged in rows. Plate of endoparameral organ an elongate subtriangular shape, moderately sclerotized; arm moderately long, and twisting.

*Pupa.*—Length of specimens at hand 3.5 mm. Respiratory organ (gill) (Fig. 12) 1.62 mm long; consisting of four rather short but

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Figs. 1–11. *Mayacnephia salasi*. Figs. 1–9, female. 1, Maxillary palpus. 2, Blade of maxilla showing retrorse teeth. 3, Tip of mandible showing serrations. 4, Enlarged view of sensory organ of third palpomere. 5, Front view of frons and ocular notches. 6, Portion of wing showing setation. 7, Genital fork (sternite 9). 8, Spermatheca. 9, Anal lobe and cercus. Figs. 10–11, male. 10, Gonocoxite and gonostylus (dorsal (inner) surface). 11, Ventral plate of aedeagus, ventral view.



Figs. 12-18. *Mayacnephia salasi*. Figs. 12-14, pupa. 12, Respiratory organ (gill). 13, Frons. 14, Abdomen showing chaetotaxy on dorsal (d) and ventral (v) surfaces. Figs. 15-18, Larva. 15, Hypostoma. 16, Inner distal and subapical margins of mandible showing dentation. 17, Antenna. 18, Hypostomal cleft.

cylindrical, inflated saelike filaments originating from a common short, rather broad base covered with minute spicules; these saelike filaments are rather uniform in length and width, nearly transparent and have a minutely granular texture that is visible only at high magnifications. Head and thoracic integument glabrous; antenna of male extending about  $\frac{1}{2}$  distance to hind margin of head; antenna of female extending about  $\frac{3}{4}$  or more of distance to hind margin of head; a single stout seta present near inner corner of each antenna, and two or three, somewhat separated, shorter and more slender setae present along outer margin of frons at about midlength of antenna (Fig. 13). Dorsum of thorax without any trace of integumental pattern; each side of thorax with about two anterodorsal and one posterodorsal, and one anteroventral and one posteroventral long, simple trichomes, anterodorsal trichomes stoutest. Chaetotaxy of each lateral half of abdominal tergites as follows (Fig. 14): tergite one with five or six fine setae; tergite two with four or five fine setae and four stouter hooks; tergites three and four each with 2–5 minute setae and four anteriorly directed spines along posterior margin; tergite five with about seven minute setae; tergite six with two or three minute setae and a row of minute, posteriorly directed spinules along anterior margin; tergite seven with three minute setae and an anterior row of minute spinules; tergite eight with two minute setae and an anterior row of minute spinules; tergite nine with a few minute spinules anteriorly, and two long caudal spines situated on two slightly swollen convexities, these spines slightly curved, tips divergent, each with a long, stout seta near base posteriorly. Chaetotaxy of each lateral half of sternites as follows: sternite three with three or four weakly sclerotized hooklets and one fine seta; sternites four and five each with four or five hooklets; sternite six with three well-developed hooks; sternite seven with two well-developed hooklets, and one pale, medial

oval area; sternite eight with one strong hooklet, and one fine seta; sternite nine with two fairly strong setae in striated membrane, plus a strong seta at base of caudal spine, otherwise bare; sternites three to eight each with a variably sized but distinct patch of minute spinules. Striated pleural membrane on each side of: segment five with two fine setae one of which is in a platelet-like sclerite; segment six with one hooklet and one fine seta in a platelet-like sclerite; segment seven with one hooklet; segment eight with one fine seta; segment nine with eight stout hooks that may be simple, bifurcate, or grapnel-shaped; intersegmental membranous area between segment eight and nine with three short but distinct nipple-like bumps on each half. Cocoon a loosely woven, saelike structure without any definite shape, and covered by detritus.

Larva (mature, with fully developed respiratory histoblasts).—Length 6.5–8.5 mm. General body color pale creamy brown; intersegmental lines narrow, slightly lighter than rest of abdomen. Head capsule pale yellowish brown; head spots pale brown but darker than surrounding fulvus area, anteromedian and posteromedian spots slender, elongate, the two sets of spots well separated, first and second anterolateral spots roundish, about equal in size and distinctly separated, posterolateral spots slightly darkened and somewhat obscure; eye spots small. Postocciput with broad gap dorsally, enclosing small cervical sclerites. Antenna (Fig. 17) pale brownish; about  $\frac{3}{4}$  as long as stalk of labral fan; proportions of segments (basal to apical) 1:7.7:2.6. Labral fan with 25–33 (av. 29) primary rays. Hypostoma as in Fig. 15, with 13 teeth arranged in three main groups of 4 + 3 + 4 plus a small tooth on each side of base of median tooth; median tooth long, subequal to longest lateral teeth of each side; each lateral group of teeth similar in structure to median group, consisting of one main tooth and a smaller tooth on each inner and outer margin, and a short, more ventral, lateral tooth; outer lateral

margins of hypostoma with 3–6 weak serrations and two or three long and one or two short hypostomal setae, with longest seta reaching tip of longest hypostomal tooth. Hypostomal cleft (Fig. 18) poorly defined, a broad, shallow, U-shaped excavation extending about  $\frac{3}{8}$  distance to base of hypostoma. Hypostomal bridge distinctly longer (25:18) than hypostoma. Mandible (Fig. 16) with one large apical tooth, three stout preapical teeth followed by a series of six or seven more seta-like teeth, and two outer teeth; inner subapical ridge with about 16–25 fine serrations. Maxillary palpus about 2.5 times as long as width at base. Lateral plate of proleg extending about  $\frac{1}{2}$  or more length of apical segment; irregularly subquadrate to subtriangular, greatest width and height nearly equal; lightly sclerotized, with about 20 very slender rod-like extensions projecting distally toward bases of hooks; circle of apical hooks arranged in about 17 rows. Segment eight of abdomen with two short, broadly rounded tubercles that extend about  $\frac{1}{6}$  to  $\frac{1}{7}$  depth of abdomen below their points of attachment. Anal papillae with three simple lobes; minute rectal setulae present lateral to anterodorsal arms of anal sclerite. Anterodorsal arms of anal sclerite about  $\frac{1}{2}$  as long as posteroventral arms; anterior arms slender, posterior arms considerably broader; sclerotized platelike junction of arms bearing 8–10 fine setae, these setae short but conspicuously longer than rectal setulae. Posterior circle of hooks consisting of about 8–10 hooks in about 62–65 rows.

**Types.**—Holotype, ♀ (mounted on five slides), temporary stream (#45a) located at one side of the road between km 96 and 97, near La Georgina on route from Cartago to San Isidro del General, Provincia San José, Costa Rica, November 14, 1983, C. R. Méndez and A. Solano V.

**Paratypes.**—1 ♀, 1 ♂, same data as type except preserved in alcohol and terminalia of both specimens mounted on slides; 1 ♂, same data except November 1, 1983 (mounted on three slides); 1 ♂, same data

except November 6, 1983 (mounted on three slides); 1 ♀, same data except November 12, 1983 (mounted on four slides); 2 ♀♀, 1 ♂ (all pinned), same data except October 28, 1983, A. Solano V. and H. Mayreno; 1 ♂ (mounted on six slides), same data except October 24, 1983, and 1 ♂ (mounted on six slides), same data except November 7, 1983, A. Solano V. and H. Mayreno; 2 pupae, same data except October 28, 1983 (one pupa mounted on two slides, the other pupa mounted on four slides); 30 pupae (four mounted on slides), same data except October 28, 1983, A. Solano V. and H. Mayreno; 13 pupae, same data except July 14, 1986, A. Solano V. and H. Mayreno; 1 larva, same data except June 7, 1983 (mounted on five slides); 1 larva, same data except June 17, 1983 (mounted on six slides); 12 larvae (five mounted on six slides each), same data except July 14, 1986, A. Solano V. and H. Mayreno.

Holotype deposited in the collection of the U.S. National Museum of Natural History, Washington, D.C. Paratypes are deposited in the U.S. National Museum of Natural History, and the entomology collection of the Department of Parasitology, University of Costa Rica.

This species is dedicated to Eng. Luis Angel Salas F., a distinguished acarologist, and Professor Emeritus at the School of Agronomy, University of Costa Rica.

**Biological notes.**—All available specimens of *M. salasi* came from the same temporary stream (numbered 45a) at the type locality. This small, shallow, clean-water stream is situated at an elevation of 3150 meters in the bottom of a deep, steep-sloped gully in an area partially to heavily shaded by forest, and with a moderate amount of vegetation on the banks. The stream is about one meter wide, with a bed of rocky sections and muddy areas. The water flows at a slow to moderate rate, has a temperature that ranges between 10–14°C, and pH values are between 7.1 and 7.8. Larvae are present in the stream throughout the year.

**Remarks.**—Wygodzinsky and Coscarón

(1973) recognized two groups of species in *Mayacnephia* based on the chaetotaxy of the abdomen and the form of the respiratory gills of the pupae. The new species described here belongs to their "apomorphic" group having a reduced number of filaments and without at least an apical filamentous portion to the filaments, as well as having a larger number of sternal setae and hooks. *Mayacnephia salasi* has only four simple, inflated, saclike filaments in the respiratory organ, and has more numerous spines on the sternal sclerites (sternite five with about 5+5, sternite six with about 3+3, and sternite seven with about 2+2) characteristic of this group of species. The recently described *M. fortunensis* Petersen (1985), from Panama, also belongs to this group.

*Mayacnephia salasi* appears to be most similar to *M. grenieri* (Vargas and Díaz Nájera) in the adult and pupal stages. The female of *M. salasi* can be most easily differentiated from *M. grenieri* by the antenna, which has a yellowish scape and pedicel that contrast with the dark brown flagellum (in *grenieri* the antenna is entirely yellow except for the black first flagellomere), the halter with its yellow knob and brownish yellow stem (knob black, stem whitish), and the genital fork whose arms diverge from the stem in a broad V-shape and have rectangular plates that are wider than long, each plate with a small, sclerotized, toothlike process on its anterior margin (arms of genital fork diverge from the stem at nearly right-angles so the posterior space between the arms is broadly U-shaped, the plates are shorter, broader and subrectangular, and each has a prominent tooth-like process). The male of *M. salasi* can be distinguished from *M. grenieri* by the all black antenna (in *grenieri* the antenna is yellow except for the black first flagellomere), the pale yellow, recumbent pile of the scutum (recumbent pile light brown), halter brown with a yellow stem (halter entirely black), and by the shape of the ventral plate of the aedeagus which, in ventral view, is more rectangular with a more broadly rounded distal margin, and

longer basal arms (more triangular in ventral view, with narrower and more pointed apical margin and much shorter basal arms).

Larvae of *M. salasi* can be distinguished from *M. grenieri* by the following combination of characters: length 6.5–8.5 mm (larvae of *grenieri* range from 8.0–9.0 mm), pale creamy brown color (distinctly yellowish but more opaque especially posteroventrally), antenna about  $\frac{3}{4}$  length of stalk of labral fan (antenna as long as stalk of labral fan), labral fan with 25–33 primary rays (40–45 primary rays), hypostoma with 13 apical teeth (9 apical teeth), hypostomal bridge distinctly longer (25:18) than hypostoma (hypostomal bridge and hypostoma nearly equal in length), and posterior circlet with 62–65 rows of hooklets (76 rows of hooklets in *grenieri*).

The species of *Mayacnephia*, as with some other groups of Simuliidae, are most easily differentiated on the basis of the number and shape of the filaments of the pupal respiratory organ (gill). The following key to the pupae of the species of *Mayacnephia* will differentiate *M. salasi* from the other described species of the genus. The pupa of *M. osborni* (Stains and Knowlton), a species described from California, does not appear in the key because it is unknown. We are unable to prepare a reliable key to the other stages of the species of *Mayacnephia* for lack of specimens. Dalmat (1955) and Díaz Nájera (1962) provided keys that include the larvae of various species now included in *Mayacnephia*, and Dalmat provided a key to the males and females of the three species known from Guatemala.

#### KEY TO SPECIES OF *MAYACNEPHIA* PUPAE

1. Respiratory organ with two long, swollen tubular filaments arranged in the form of a V (figs. 17–18 in Dalmat 1949; fig. 10B in Wygodzinsky and Coscarón 1973). Highlands of Guatemala, Mexico (Chiapas) *agurrei* (Dalmat)
- Respiratory organ with three or more filaments of varying form and arrangement . . . . . 2
2. Respiratory organ with three long, swollen, tubular filaments (fig. 20 in Díaz Nájera 1962). Mexico (Oaxaca) . . . . . *mixensis* (Díaz Nájera)



- Respiratory organ with four or more filaments of varying form ..... 3
- 3. Respiratory organ with four filaments ..... 4
- Respiratory organ with six or more filaments ..... 5
- 4. Filaments short, inflated and saclike with broadly rounded tips, all arising from a common base (fig. 12 herein), Costa Rica ..... *salasi* n. sp.
- Filaments longer, swollen but not greatly inflated or saclike, tubular with pointed apices, arranged in two pairs (fig. 22 in Vargas and Díaz Nájera 1948; fig. 9A in Wygodzinsky and Coscarón 1973), Mexico (Veracruz) ..... *grenieri* (Vargas and Díaz Nájera)
- 5. Respiratory organ with six long, swollen, tubular filaments that are rounded distally, anterior two filaments single, posterior two filaments branching into two petiolate pairs (fig. 4 in Coleman 1953), California ..... *stewarti* (Coleman)
- Respiratory organ with seven or more filaments of varying form ..... 6
- 6. Respiratory organ with seven or eight filaments ..... 7
- Respiratory organ with 11-15 filaments ..... 9
- 7. Respiratory organ with seven filaments ..... 8
- Respiratory organ with eight filaments (fig. 27 in Currie 1986), Western Canada ..... (unnamed species X)
- 8. Respiratory organ with four swollen, tubular filaments, three of which, in turn, give rise to two slender filaments distally, and the fourth which has a single slender terminal filament (fig. 8A in Wygodzinsky and Coscarón 1973), Highlands of Guatemala ..... *roblesi* (León)
- Respiratory organ with four swollen, tubular, clavate filaments; anteromedial and posteromedial filaments unbranched although the former sometimes with a variably developed thumblike hump on its mesal surface; anterolateral filament branching into two petiolate filaments, and posterolateral filament branching into three filaments (fig. 8 in Petersen 1985), Panama ..... *fortunensis* Petersen
- 9. Respiratory organ with 11-12 filaments ..... 10
- Respiratory organ with 14-15 filaments arising from four thickened main trunks (figs. 13-18 in Díaz Nájera 1971), Mexico (Coahuila) ..... *muzquicensis* (Díaz Nájera)
- 10. Respiratory organ with 11 tubular filaments that are variably swollen basally, some of the filaments are much longer than the others (fig. 9 in Díaz Nájera 1962), Mexico (Morelos) ..... *atzompensis* (Díaz Nájera)
- Respiratory organ with 11-12 long, slender, tapering filaments and one short, medial filament, filaments branching fanlike horizon-

tally (fig. 6H in Wygodzinsky and Coscarón 1973), Guatemala, Mexico (Chiapas) ..... *pachecolunai* (León)

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